A Noncognitive Temperament Test to Predict Risk of Mental Disorders and Attrition in U.S. Army Recruits

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ABSTRACT U.S. military accession mental health screening includes cognitive testing and questions regarding the applicants' past mental health history. This process relies on applicants' knowledge of and willingness to disclose symptoms and conditions. Applicants have a strong incentive to appear qualified, which has resulted in a long history of frequent mental health conditions presenting during recruit training. Objective: To assess the predictive value of a pre-enlistment noncognitive temperament test score for risk of mental disorders and attrition in the first year of service. Methods: A retrospective cohort study was conducted on non-high school diploma U.S. Army active duty recruits who took the Assessment of Individual Motivation (AIM). Multivariate logistic regression models were used to determine associations between AIM score quintiles, mental disorders, and attrition. Results: AIM scorers in the lowest quintile were at increased risk for a mental disorder (OR, 1.44; 95% CI, 1.35–1.53) and of discharge (OR, 1.65; 95% CI, 1.44–1.68) compared to AIM scorers in the highest quintile, with significant linear trends for decreased risk with increasing AIM score. Conclusions: AIM offers the potential to improve screening of military applicants and reduce mental disorders and attrition in new recruits beyond the current process.

INTRODUCTION

The current U.S. military accession mental health screening process includes a series of yes/no questions regarding the applicants' past mental health history such as anxiety, depression, suicide, counseling, and drug abuse. This process relies on applicants' knowledge of and willingness to disclose symptoms and conditions that may be disqualifying for military service. Applicants have a strong incentive to appear qualified, which has resulted in a long history of frequent mental health conditions presenting during recruit training and the first tour of duty.[1]

Psychiatric morbidity and attrition from service lead to the loss of monetary and other resources invested in recruiting, accessing, and training military personnel. Psychiatric disorders are among the top ten causes of existed-before-service and disability discharges each year.[2] Psychiatric disorders are also the most common reasons for hospitalizations in service men and women (excluding delivery-related hospitalizations in women).[3] However, accurate predictions of individual psychiatric morbidity or attrition are both elusive and illusive.[4]

Cognitive screening of U.S. Army applicants includes two measures, the Armed Forces Qualification Test (AFQT), which is a verbal and math score from the Armed Services Vocational Aptitude Battery, and educational achievement.[1] Although the AFQT in conjunction with educational achievement has historically proven to be a useful metric for selecting new Soldiers,[5] other personal attributes, in particular noncognitive attributes (e.g., temperament, interests, and values), have recently been found to have additional value in predicting entry-level Soldier performance and retention.[6,7] Noncognitive tests measure personality indicators of adaptability for military service, potentially enhancing the current cognitive screening process.

The Assessment of Individual Motivation (AIM) is a noncognitive test developed by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) as an accession screen for attrition and overall individual success as a Soldier.[8] AIM collects self-reported personality information about past experiences and behaviors, identifying applicants not well adapted or motivated for military service.[8] Because mental health disorders are a major cause of existed-before-service and disability discharges, hospitalizations, ambulatory care, and early attrition, AIM's ability to select applicants not well-suited for military life may have an important alternate use in predicting mental disorder diagnosis. The purpose of this study is to determine if AIM is associated with mental disorder diagnosis and attrition in the first year of service.

METHODS

A retrospective cohort study of Tier 2 (non-high school graduate) U.S. Army accessions was conducted to determine whether AIM score is associated with attrition or mental disorder diagnosis in the first year of service.

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AIM Screening Tool

After undergoing validation from 1998 to 1999, AIM was implemented in 2001 as an attrition screen for non-high school graduates, who have historically had higher attrition rates compared to recruits with a high school diploma. AIM was designed to augment existing cognitive attrition screens in the non-high school graduate applicant population, particularly during challenging recruiting environments, by identifying potential recruits with better adaptability for military careers. AIM is administered at the Military Entrance Processing Stations (MEPS) and is a 20-minute self-report measure utilizing a forced-choice format in which applicants must choose among four statements to describe their temperament and interests, focusing on past behavior and experiences.[8]

AIM incorporates two strategies for reducing the applicant's ability to fake a favorable score, including balanced statements within a tetrad to minimize the impact of social desirability of the choices and an emphasis on behavioral content in the self-descriptive statements.[8] AIM assesses the applicant's behavioral trends in six areas, which include work orientation, adjustment, agreeableness, dependability, leadership, and physical conditioning. The AIM composite score is a simple unit weighting of the component scales and was used for attrition screening.[8] AIM was modified in 2005 to increase its validity at which time the scoring key was changed, more optimally weighting the component scales to predict attrition. Details of AIM have been provided elsewhere.[8]

Study Population

Individuals in the study were Tier 2 U.S. Army active duty accessions with no prior military service that completed AIM at any of the 65 MEPS between January 2005 and September 2009. Individuals were excluded if they failed to answer at least 75% of the AIM questions or were missing any of their AIM subscale scores ($N = 33$).

DATA SOURCES

Accession

Individuals who completed AIM between 2005 and 2009 were identified in the U.S. Military Entrance Processing Command (USMEPCOM) data and matched to the AIM database ($N = 57{,}597$). Tier 2 individuals who met the inclusion criteria were selected ($N = 47{,}979$) and matched to accession data from USMEPCOM and the Defense Manpower Data Center (DMDC). For each individual, ARI provided an AIM composite score and six subscale scores.

Accession factors of interest were sex, age, race/ethnicity, body mass index (BMI) category, AFQT score, medical conditions present at application for military service, and medical waivers. The U.S. Army Recruiting Command provided medical waiver dates and diagnoses. Only medical waiver considerations reviewed by the U.S. Army waiver authority within two years before accession were included in this study.

Attrition

Discharge dates and Interservice Separation Codes (ISC) from DMDC were used to calculate overall attrition during the first year of service because attrition rates are historically highest during the first six months to one year of service.[2] Separations as result of immediate re-enlistment, early release, acceptance into officer training programs and battle casualties were not defined as attrition. One-year attrition was also divided into five different categories of attrition based on the ISC: medical, behavior, performance (i.e., Army physical fitness test or weapons qualification failure), failure to meet weight for height or body fat standards, and other.

Mental Health Disorders

The Patient Administration Systems and Biostatistics Activity provided ambulatory health care data from the Standard Ambulatory Data Record for all visits at Military Treatment Facilities between 2005 and 2010. Mental disorders were defined according to The International Classification of Diseases, Ninth Revision (ICD-9) as having a diagnosis with ICD-9 codes between 290 and 319 in any diagnosis position. Guided by the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition,[9] mental disorders were divided into the following diagnostic categories: psychoses, affective disorders, anxiety disorders, personality disorders, substance use disorders, adjustment disorders, and other nonpsychotic conditions. All mental disorder codes during the first year of service were counted and the mental disorder categories were not mutually exclusive.

STATISTICAL ANALYSIS

Individuals were divided into quintiles based on their AIM composite score. Quintile 1 (Q1) included the lowest AIM scorers and Quintile 5 (Q5) included the highest. Each quintile does not reflect exactly 20% of the population because some frequent scores spanned quintiles, and all scores of the same value were placed in the same quintile. All attrition and morbidity outcomes were dichotomous. In the specific-cause attrition analysis, only individuals who did not attrit were compared to those in each attrition category for the analysis.

Unadjusted relative risks were calculated to determine associations between AIM score quintile and attrition or morbidity during the first year of service. Adjusted odds ratios (ORs) were calculated using multivariate logistic regression for all attrition and morbidity outcomes. Utilization rate ratios (URRs) were calculated by log-linear modeling, assuming a Poisson distribution. Overall health care utilization was determined by counting all ambulatory visits on separate days for individuals with at least one ambulatory encounter. Mental health utilization was determined by counting mental health visits on separate days for individuals with at least one mental disorder diagnosis. The accession factors sex, age, race/ethnicity, BMI, AFQT score, conditions present at application, and medical waiver were included in

the models. All statistical analyses were performed using SAS version 9.2 (SAS Institute, Cary, North Carolina). This study was approved by the Walter Reed Army Institute of Research Institutional Review Board.

RESULTS

Demographics

Table I shows that the study population was primarily male, under age 25, and white, with a BMI in the normal or overweight categories. Sex was associated with AIM composite score with females scoring lower than males. AIM composite score had a low correlation with AFQT ($r = 0.04$, $p < 0.0001$).

Attrition

AIM scorers in the lowest quintile had the highest overall rates of attrition (23.7%), whereas AIM scorers in the highest quintile had the lowest rates of attrition (14.7%), and there was a significant linear trend for decreasing risk of attrition with increasing AIM score for each quintile ($\chi^2 = 302.905$, $p < 0.0001$, df = 4). As shown in Figure 1, for specific types of attrition, the lowest AIM quintile consistently had the highest rates of attrition, with medical and behavior attrition most prevalent across all quintiles.

As shown in Table II, the lowest AIM composite score quintiles were found to be associated with all cause and each category of attrition in the first year of service, after adjustment for age, sex, race, BMI, AFQT score, medical conditions, and medical waiver. Individuals scoring in the lowest quintile had 56% greater odds of all-cause attrition within the first year of service compared to those scoring in the highest quintile. Stratified analysis by sex found a similar association for men and women (data not shown).

Mental Health Disorders

Forty-six percent of individuals in the lowest quintile had a mental disorder during the first year of service compared to 34.5% of individuals in the highest quintile. Substance use (25.9%), adjustment (15.3%), and affective disorders (8.7%) were the most common types of mental disorders overall and across all quintiles. Figure 2 shows that rates of mental disorders decreased across quintiles as AIM composite score increased, with a significant linear trend present ($\chi^2 = 325.021$, $p < 0.0001$, df = 4) for all mental disorders. The lowest quintile had the highest rates of all types of mental disorders.

Table III shows that the lowest quintile had increased odds of all types of mental disorders compared to the highest

TABLE I. Demographics of Population by AIM Composite Score Quintile (Q)

Demographics	Q1 (Low), $N = 10,145$	Q2, $N = 9,868$	Q3, $N = 7,938$	Q4, $N = 10,972$	Q5 (High), $N = 9,056$
Sex					
Male	80.9	86.8	89.7	92.6	95.7
Female	19.1	13.2	10.3	7.4	4.3
Age at Enlistment					
17–20	64.0	61.8	61.9	61.7	61.5
21–25	25.4	27.9	28.4	28.3	29.3
26–30	6.4	6.3	6.1	6.1	5.8
>30	4.2	3.9	3.6	3.8	3.4
Race/Ethnicity[a]					
White, Not Hispanic	76.8	77.0	77.5	78.9	79.3
Black, Not Hispanic	8.5	8.7	8.0	7.5	6.8
Hispanic	11.4	11.0	11.3	10.6	11.0
Other, Not Hispanic	2.4	2.5	2.5	2.3	2.5
BMI[a]					
Underweight	4.0	3.6	3.0	2.9	2.4
Normal	50.9	52.6	54.8	55.7	58.9
Overweight	30.9	31.0	30.2	29.9	29.0
Obese	12.8	11.5	10.6	10.3	8.5
AFQT[a]					
11–29	0.4	0.3	0.3	0.3	0.2
30–49	38.9	38.8	38.8	34.8	31.7
50–64	31.6	32.6	33.5	35.0	35.2
65–92	27.4	26.9	26.1	28.5	31.4
93–99	1.8	1.3	1.4	1.4	1.5
Medical Conditions					
No	83.9	85.3	86.7	86.7	87.7
Yes	16.1	14.7	13.3	13.3	12.3
Medical Waiver					
No	94.0	93.9	94.7	93.8	94.2
Yes	6.0	6.1	5.3	6.2	5.8

[a]Does not sum to 100% because of missing values.

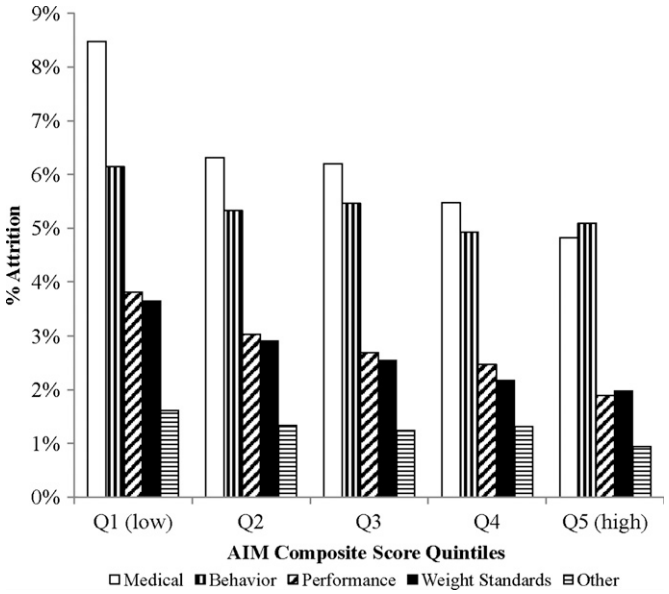

FIGURE 1. Attrition rate within first year of service by AIM composite score quintiles (Q).

quintile, after adjustment for age, sex, race, BMI, AFQT score, medical disqualification, and medical waiver. Overall, individuals scoring in the lowest quintile had 44% greater odds of having a mental disorder within the first year of service compared to those scoring in the highest quintile. AIM composite score quintile was most highly associated with affective, adjustment, and personality disorders with the lowest quintile having a 1.6 times increased odds for each of these types of mental disorder and a significant linear trend for decreasing risk with increasing AIM composite score for each. Stratified analysis by sex found similar associations for men and women (data not shown).

Utilization

As shown in Table IV, utilization rates (URs) for ambulatory care during the first year of service were also associated with AIM quintile. The lowest quintile had increased URs of ambulatory care for all conditions during the first year of service with a URR 1.24 (95% CI, 1.23–1.26) for AIM scorers in the lowest quintile compared to AIM scorers in the highest quintile. Among individuals with mental disorders, the URR was 1.08 (95% CI, 1.06–1.11) for the lowest quintile compared to the highest quintile.

Number Needed to Screen

A number needed to screen analysis was also completed to evaluate AIM as a potential screening tool. AIM composite scores were separated into deciles to determine a cut point for AIM composite score that could be used to screen applicants at increased risk of mental disorders and attrition. For an AIM composite score of 41, marking the lowest quintile (bottom 20%) as a cut point, 14 applicants would need to be tested with AIM in order to identify one future mental disorder diagnosis and 15 applicants tested in order to identify one future attrition.

AIM Subscale Analysis

The attrition and mental disorder analyses were also performed with the subscale scores. The physical conditioning subscale score was the most predictive of attrition and mental disorder diagnosis, although the association was not as strong as the composite score. Individuals scoring in the lowest quintile on the physical conditioning subscale were at increased risk of both attrition (OR, 1.31; 95% CI, 1.22–1.41) and mental disorders (OR, 1.32; 95% CI, 1.25–1.40). Scorers in the lowest quintile for the work orientation subscale were also at increased risk of both attrition (RR, 1.24; 95% CI, 1.15–1.34) and mental disorders (RR, 1.16; 95% CI, 1.10–1.24). For all of these subscores and endpoints, significant linear trends were observed, reflecting decreased risk with increasing scores.

DISCUSSION

In this study, 47,979 non-high school graduate, nonprior service, active duty Army accessions completed a noncognitive personality test and were followed for ambulatory care mental disorder diagnoses and attrition in the first year of service. AIM scorers in the lowest quintile had the highest rates of attrition (23.7%), whereas AIM scorers in the highest quintile had the lowest rates of attrition (14.7%). Medical and behavioral causes were the most prevalent types of attrition across AIM quintiles. Forty-six percent of lowest AIM scorers received a mental disorder diagnosis compared to 34.5% of highest scorers. When adjusted for sex, age, race/ethnicity,

TABLE II. Adjusted ORs for Attrition in the First Year of Service by AIM Composite Score Quintile (Q)

Attrition Type	Q1 vs. Q5, OR (95% CI)	Q2 vs. Q5, OR (95% CI)	Q3 vs. Q5, OR (95% CI)	Q4 vs. Q5, OR (95% CI)
All-Cause	1.56 (1.44–1.68)	1.24 (1.15–1.34)	1.22 (1.12–1.32)	1.10 (1.02–1.19)
Medical	1.65 (1.46–1.87)	1.24 (1.09–1.41)	1.25 (1.10–1.44)	1.10 (0.97–1.25)
Behavior	1.23 (1.08–1.39)	1.04 (0.91–1.18)	1.07 (0.93–1.23)	0.96 (0.85–1.10)
Performance	1.92 (1.60–2.31)	1.52 (1.26–1.85)	1.39 (1.13–1.70)	1.27 (1.05–1.54)
Weight Standards	1.66 (1.42–1.95)	1.43 (1.21–1.68)	1.28 (1.07–1.52)	1.03 (0.87–1.22)
Other	1.43 (1.09–1.88)	1.24 (0.94–1.64)	1.22 (0.91–1.63)	1.32 (1.00–1.73)

ORs were adjusted for sex, age, race, BMI, medical conditions, medical waivers, and AFQT score.

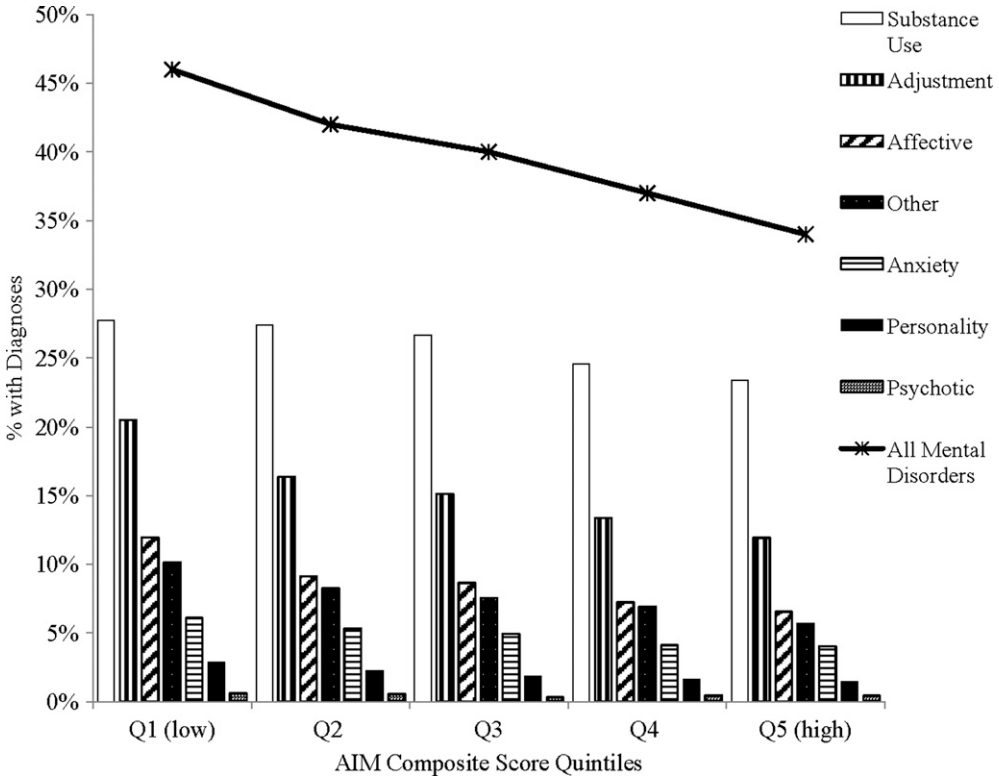

FIGURE 2. Incidence of categories of ambulatory mental disorders by AIM composite score quintiles.

BMI, AFQT, medical waivers, and the presence of medical conditions at enlistment, AIM scorers in the lowest quintile had 56% greater odds of all-cause attrition and 44% greater odds of mental disorder diagnoses compared to those scoring in the highest quintile. AIM composite score quintile was most highly associated with affective, adjustment, and personality disorders with the lowest quintile having a 1.6 times increased odds for each of these types of mental disorder. Most outcomes were associated with significant linear trends, with risks decreasing with increasing AIM composite scores. In addition, those with lower AIM scores had increased health care utilization in general and for mental disorders specifically.

To our knowledge, this study is the first to assess the use of a noncognitive personality test in predicting ambulatory care mental disorder diagnosis and attrition within the first year of military service after adjusting for multiple known accession and attrition risk factors including cognitive measures. Strengths of this analysis include the large study population, comprehensive data capture for ambulatory health care, attrition from service, and demographic information. Additionally, the AIM test, unlike traditional aptitude measures, does not rely on cognitive ability or education level, instead focusing on personality traits associated with adaptability for military service.[8] AIM also limits the test taker's ability to fake a favorable outcome by utilizing balanced statements emphasizing behavioral content.[8] The study findings need to be replicated in other Services before they can be generalized to the general military population. AIM was developed for, administered to, and validated in non-high school graduate enlistees who are historically at greater risk of early attrition.[8]

In order to meet military recruiting and mission goals, an accession screening tool must assess individual potential for

TABLE III. Adjusted ORs of Ambulatory Mental Disorders by AIM Composite Score Quintile (Q)

Mental Disorder	Q1 vs. Q5, OR (95% CI)	Q2 vs. Q5, OR (95% CI)	Q3 vs. Q5, OR (95% CI)	Q4 vs. Q5, OR (95% CI)
All Mental Disorders	1.44 (1.35–1.53)	1.29 (1.21–1.37)	1.23 (1.15–1.31)	1.09 (1.03–1.16)
Affective	1.60 (1.44–1.78)	1.28 (1.15–1.43)	1.26 (1.12–1.41)	1.07 (0.95–1.19)
Anxiety	1.29 (1.13–1.49)	1.22 (1.06–1.40)	1.18 (1.01–1.36)	0.99 (0.86–1.14)
Personality	1.63 (1.31–2.02)	1.40 (1.12–1.74)	1.18 (0.93–1.50)	1.07 (0.85–1.35)
Substance Use	1.19 (1.11–1.27)	1.20 (1.12–1.28)	1.16 (1.09–1.25)	1.05 (0.99–1.13)
Adjustment	1.62 (1.49–1.76)	1.31 (1.20–1.43)	1.24 (1.14–1.36)	1.10 (1.01–1.19)
Other	1.59 (1.42–1.78)	1.35 (1.20–1.52)	1.28 (1.13–1.45)	1.21 (1.08–1.36)

Substance use includes Tobacco use disorder (ICD-9 code 305.1), which accounted for 69% of individuals categorized as having a substance use disorder without any record of drug or alcohol abuse disorders.

TABLE IV. URs and Adjusted Rate Ratios (URR) of Ambulatory Visits by AIM Composite Score Quintile (Q)

	Utilization	100 p-d	UR	URR (95% CI)
All Ambulatory Visits				
Q1 (Low)	106,636	30,894.85	3.45	1.24 (1.23–1.26)
Q2	91,673	30,786.91	2.98	1.13 (1.12–1.14)
Q3	70,987	25,017.58	2.84	1.11 (1.10–1.12)
Q4	92,003	34,569.73	2.66	1.06 (1.05–1.07)
Q5 (High)	69,503	28,552.57	2.43	REF
Mental Disorder Visits				
Q1 (Low)	22,045	13,906.45	1.59	1.08 (1.06–1.11)
Q2	18,651	12,785.76	1.46	1.02 (1.00–1.04)
Q3	14,023	9,987.59	1.40	1.00 (0.97–1.02)
Q4	17,526	12,910.65	1.36	0.96 (0.94–0.99)
Q5 (High)	13,740	9,864.67	1.39	REF

Model adjusted for sex, age, race, BMI, medical conditions, medical waivers, and AFQT score. p-d, rate per 100-person-days.

entry and success in service, improve person–job match, and accommodate changing mission and recruiting requirements. Despite a detailed medical history and physical examination at accession, early discharge from military service for pre-existing mental health disorders commonly occurs.[2] A valid accession mental health screen is needed that will predict first term mental illness and related discharges while remaining robust in a setting where military applicants have a strong incentive to appear qualified for enlistment. AIM was shown to predict attrition and mental disorder diagnosis within the first year of military service when implemented at enlistment. AIM has potential use as an accession mental health screening tool, augmenting current cognitive measures of overall success in a military career, as a means of identifying individuals at increased risk of mental health disorders and premature discharges. Applicants identified as at higher risk of mental disorder diagnosis and related discharges might then undergo more in-depth medical examination through mental health referral in order to identify disqualifying mental health disorders.

Additional research is needed to determine the utility of noncognitive, personality tests as screening tools for mental health fitness and success in military service, particularly in the applicant population other than non-high school graduates. Important areas of future research include analysis of the Tailored Adaptive Personality Assessment System (TAPAS), a more sophisticated noncognitive screening tool also developed by ARI which expands on the AIM test by adding temperament dimensions. A retrospective epidemiologic study is currently planned to assess the predictive value of TAPAS on 6 month and 1-year psychiatric morbidity and attrition. The noncognitive personality tests AIM and TAPAS, developed to assess enlistees' adaptability for military life, provide areas of future study as screens for psychiatric morbidity and related premature discharges, identifying both at risk applicants for in-depth examination in favorable recruiting environments as well as lower risk applicants for potential medical waiver consideration during periods of challenging recruitment.

This study is the first to document a preaccession noncognitive screen of U.S. Army applicants that significantly predicts mental disorder diagnoses and attrition in the first year of service. AIM and its successor TAPAS offer the potential to reduce the burden of undiagnosed and concealed pre-existing mental disorders in new accessions. Further analysis is needed to establish an accession composite risk profile including metrics such as AIM and TAPAS to predict success in military service and risk for mental disorder diagnosis in the first tour of duty.

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